NASA SBIR/STTR Technologies

H2.02-7555 - Joining of Tungsten Cermet Nuclear Fuel

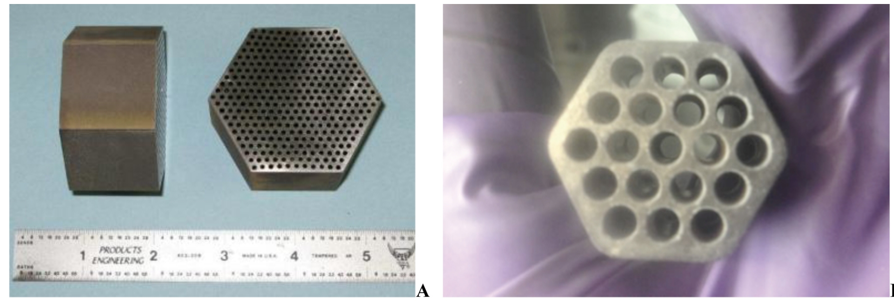
PI: John O'Dell

Plasma Processes, LLC - Huntsville, AL

Identification and Significance of Innovation

Nuclear Thermal Propulsion (NTP) has been identified as a critical technology needed for human missions to Mars due to its increased specific impulse. A critical aspect of the program is to develop a robust, stable nuclear fuel. One of the nuclear fuel configurations currently being evaluated is a cermet material comprised of uranium dioxide (UO2) particles encased in a tungsten matrix (W). Although subscale W cermet segments have been successfully produced, the fabrication of full-size W cermet elements using powder feedstock materials has proven to be difficult. As a result, the use of W cermet segments to produce a full-size W cermet fuel element is of interest. However, techniques for joining the segments are needed that will not lower the use temperature, damage the UO2 particles, or compromise the nuclear performance of the fuel. For these reasons, joining of the segments using braze or weld techniques is not desired. Therefore, diffusion bonding techniques will be developed during this investigation for producing full-size nuclear fuel rods from W cermet segments.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



A B

Figure 1 – W cermet fuel rod segments: A) NASA-MSFC: 331 channel W cermet fuel segment produced by HIP processing of powders and then removal of sacrificial molybdenum mandrels, and B) CSNR: 19 channel W cermet fuel segment produced by SPS processing of powders (¾" diameter x ¾" length).

Technical Objectives and Work Plan

- Develop HIP diffusion bonding for joining W cermet segments.
- Evaluate the use of interfacial refractory metal coatings on W samples to enhance diffusion during HIP diffusion bonding.
- Characterize the coatings and the joints formed during HIP diffusion bonding.
- Perform preliminary properties test to determine the bond strength of the joints produced during diffusion bonding.
- Fabricate simulated W based fuel rod to demonstrate proof of concept.

NASA Applications

NASA applications benefiting from this technology include Nuclear Thermal Propulsion (NTP) and Nuclear Electric Propulsion (NEP). Potential NASA missions include rapid robotic exploration missions throughout the solar system and piloted missions to Mars and other destinations such as near earth asteroids.

Non-NASA Applications

Commercial sectors that will benefit from this technology include medical, power generation, electronics, defense, aerospace, chemicals, and corrosion protection. Specific applications include protective coatings, x-ray targets, valves, non-eroding throats and thrusters for propulsion, and crucible/furnace components.

Firm Contacts

Timothy McKechnie
Plasma Processes, LLC
4914 Moores Mill Road
Huntsville, AL, 35811-1558
PHONE: (256) 851-7653
FAX: (256) 859-4134

NON-PROPRIETARY DATA